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| **Abstract** | (see below) |
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**Adaptive quantization for speech enhancement in wireless acoustic sensor networks**

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**Abstract**

Speech enhancement is a field in audio signal processing where the goal is to improve the quality and/or intelligibility of a speech signal corrupted by noise. Typical applications include speech communication, speech recognition, hearing aids, etc. Algorithms making use of microphone arrays exploit spatial diversity to increase the performance of single-microphone algorithms [1].

However, since the number of microphones that a single device can carry is typically limited, one solution is to use multiple nodes equipped with both a microphone array and a wireless communications module to form a system known as wireless acoustic sensor network (WASN) [2]. This results in a higher spatial diversity and increased probability to have microphones close to the desired sound sources, which means having access to high signal-to-noise ratio (SNR) signals. Such a system comes with technical challenges of its own, in particular energy efficiency is crucial as nodes are usually powered by batteries. Since wireless communication is usually more expensive than data processing [3], it is essential to reduce the data exchange.

In this paper we show how adaptive quantization can be applied to the multi-channel Wiener filter [4] for speech enhancement in a WASN. Adaptive quantization aims to assign, for each microphone in the network, the optimal number of bits used to encode its samples depending on the usefulness of its signal for the enhancement task. This helps to reduce the energy consumption of the nodes since nodes with less important signals need to transmit fewer bits. Our adaptive quantization scheme is based on a metric called *impact* of the quantization noise, which quantifies the increase in minimum mean squared error (MMSE) for a linear estimator when quantization noise is added in an arbitrary channel and the estimator is reoptimized. This metric was shown to generalize the *utility* metric, which quantifies the increase in MMSE when a signal is removed from the estimation and the estimator is reoptimized [5], and used for a greedy adaptive quantization scheme in [6].

Our contribution is twofold, first we consider the MMSE as a function of the power of the noise added to each signal, and we show that the impact metric has two asymptotic cases, the utility [5] when the noise power tends to infinity and the gradient when the noise power is infinitesimally small. Second, we illustrate how the impact metric can be used to perform adaptive quantization in a speech enhancement task using real recorded data and the effect on the total bandwidth of the network.

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